Space Weather Technical Forecast

Issued on Thursday 31 October 2024 at 01:07 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-flares expected, a chance of X-class flares. S1 Minor Storm easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M7.2 at 30/2053 UTC from AR3878 in the northeast, which currently has a persistent delta spot, some growth of intermediate regions, and bright looping in SDO/aia imagery suggests an ongoing flare risk. This is one of thirteen regions currently on the Earth-facing disc, however the other regions have remained largely inactive, limited to only C-class flaring with either a stabilising or declining trend. AR3869 is perhaps the main exception, as this has seen its trailer and leader spots, in reverse configuration for SC25, approach each other and potentially increase instability and the flare potential across the region. This is also bisected by a small filament, which adds to the regions complexity.

No Earth-directed CMEs were observed in available imagery. A broad coronal dimming was observed across the western disc around 30/1250 UTC, and while no clear CME has been identified further analysis is ongoing. No CME has yet to be observed from the M7.2 flare.

Solar Wind / Geomagnetic Activity: Ongoing fast winds were observed, likely associated with CH85, which is now just on or over the west limb. Solar wind speeds, observed by ACE at L1, were slightly elevated to elevated, but also highly variable, between 480-550 km/s. Density was below average. Interplanetary Magnetic Field (IMF), Bt, was weak around 5-8nT, with the north-south component, Bz, varying weakly between -8nT and +7nT. Phi angle was predominately negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp1-4).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at S1 Minor Radiation Storm throughout, easing from around 71pfu at 30/0000 UTC, to 24pfu by 30/2145 UTC. A small recovery was then observed to finish the period at 32pfu by 30/2330 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate. The associated 24-hour fluence was well below the Active threshold, with 4.43e6 integrated flux observed at 30/2100UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected to continue through the period, with isolated M-class flares expected and a chance of an isolated X-class flare.

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Solar Wind / Geomagnetic Activity: There are no CME arrivals currently expected, however given the number of active regions and filaments on the disc, this may change at short notice. Current fast winds expected to slowly ease towards background through days 1-2 (31 Oct-01 Nov). The next enhancement is, from CH86/+ is most likely beyond this period, but with a slight chance of onset late day 4 (03 Nov). Mainly Quiet geomagnetic activity is expected, with a isolated Unsettled intervals. There is only a slight chance of Active to G1 Minor Storms later in the period from any enhancements that occur

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is currently at S1 Moderate Radiation Storm, but slowly declining, and likely falling below this level later day 1 (31 Oct) or perhaps early day 2 (01 Nov). However, any further notable flares will bring the potential for further enhancement. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active.

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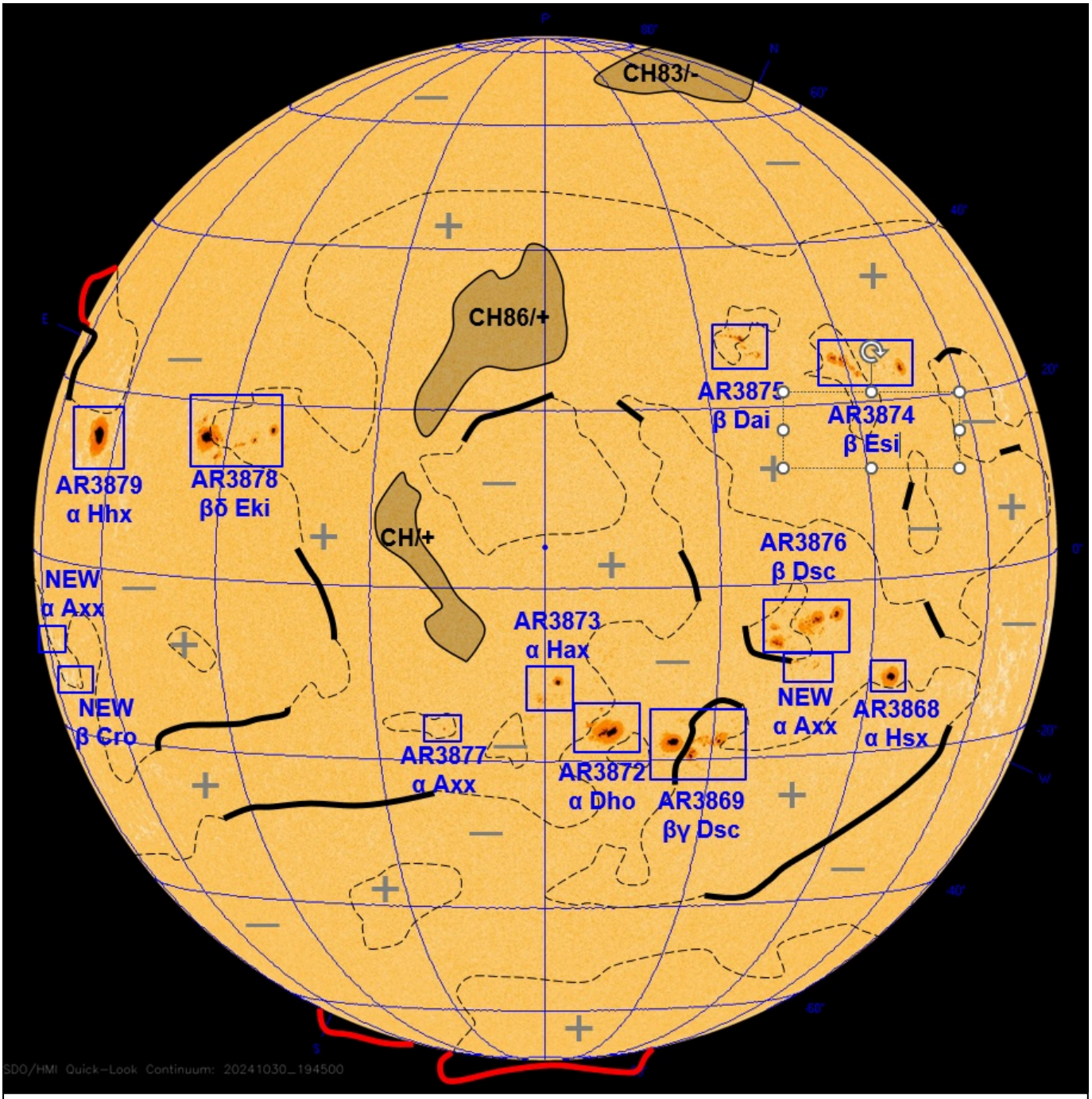
Figure 1: Solar Synoptic Map 30/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs expected. However, given recent imagery issues and the number of filaments on the Earth-facing disc, along with the continued chance for notable flares, this has the potential to change at short notice and is lower than usual confidence.

Current fast winds, most likely associated with CH85/-, are expected to slowly ease through days 1-2 (31 Oct-01 Nov), but may persist at slightly elevated levels, as indicated but MOSOWC Enlil, which is currently giving good guidance. No other enhancements are expected in the period, with the next coronal hole enhancement likely from CH86/+, or its southern portion, most likely to occur beyond this forecast period, but with a slight chance by the end of day 4 (03 Nov).

Mainly Quiet geomagnetic activity is expected, with a isolated Unsettled intervals. There is only a slight chance of Active to G1 Minor Storms later in the period from any enhancements that occur

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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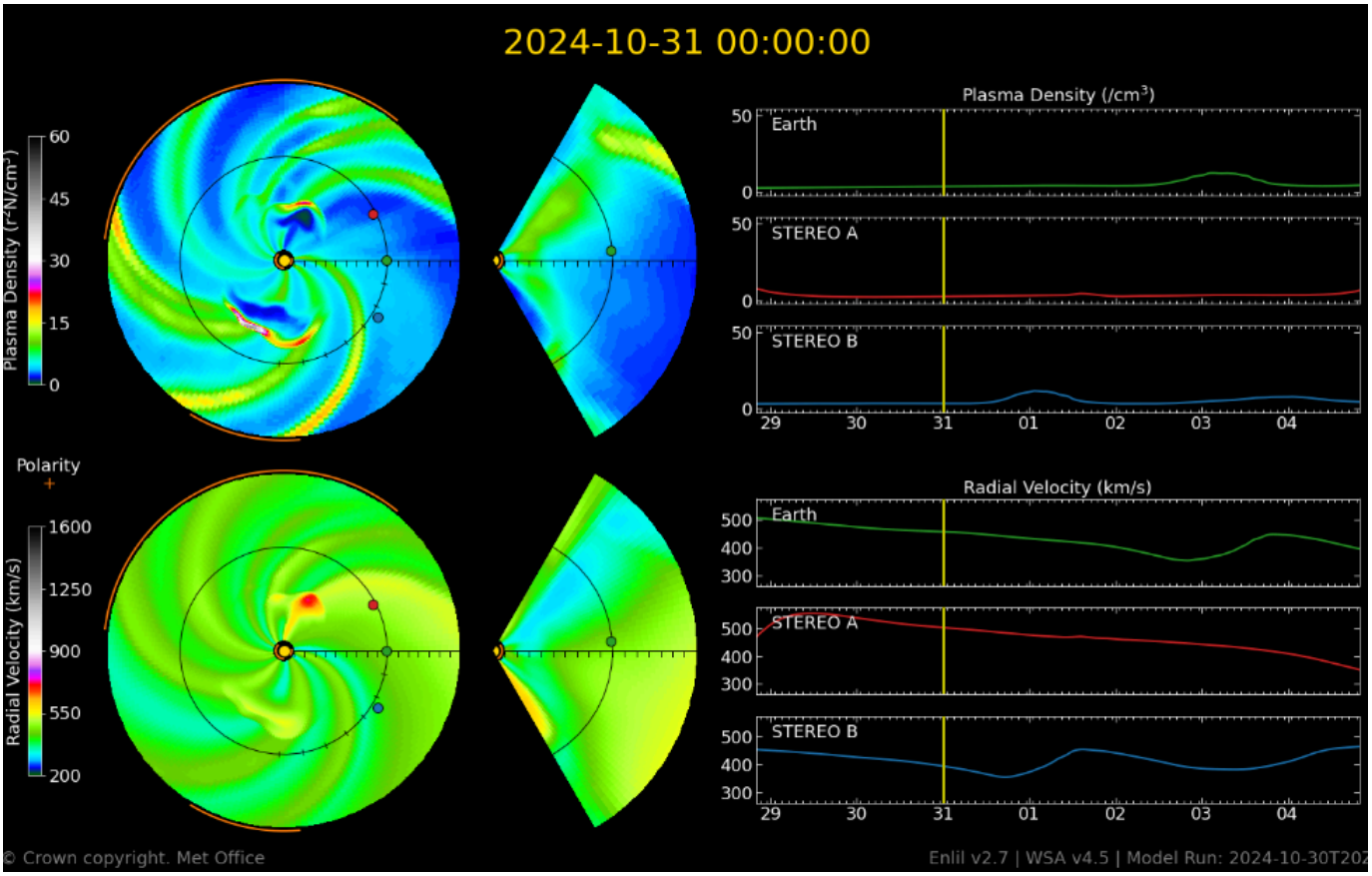
Figure 2: MOSWOC Enlil



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Radio Blackouts - X-Ray Flares

Generally Moderate activity is expected to continue through the period, with occasional M-class flares expected and a chance of an isolated X-class flare.

There are thirteen active regions currently on the the disc, with the most active AR3878 in the northeast. This region maintains a delta spot on its trailer, despite the recent M7.2 flare and is bright in SDO aia-imagery, suggesting further activity is likely. There are a number of active regions across the southwest disc, which also provide a smaller, but non-zero notable flare risk. The most likely of these is AR3869, with its negative trailer spot and positive leader spot currently moving closer together which is likely to increase instability across the region. This is closely followed by AR3872 and AR3873, to form a cluster of three spots that were the sources of the most recent X-class flares. However these two spots have shown a slow declining trend.

Also of note are AR3876 in the southwest disc, but to the northwest of this cluster, and AR3875/74 in the northwest disc. These are relatively simple regions but have shown varying degrees of development over the last few days. While largely inactive so far, these also contribute a slight chance to the overall flare risk. The other regions are generally smaller or simpler, including the large AR3879 in the northeast which is likely the returning region ex-AR3848 which produce the X-class flare, and notable CME arrival on the previous rotation.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	75	75	75
Very Active	R3-R5 (X Class)	No	30	25	20	20

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Figure 3: GOES 16-18 X-ray Irradiance

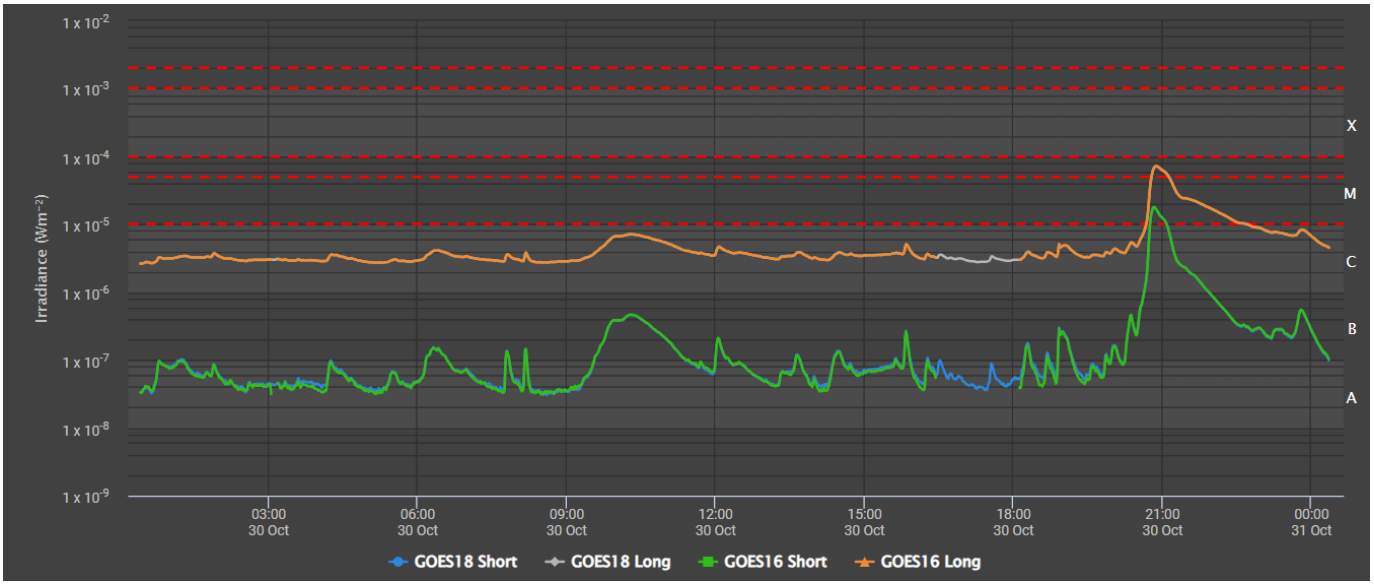

Figure 4: SDO imagery of the south and southwest disc, showing a number of Active regions. The most likely flare source out of these is now the southern most region, AR3869

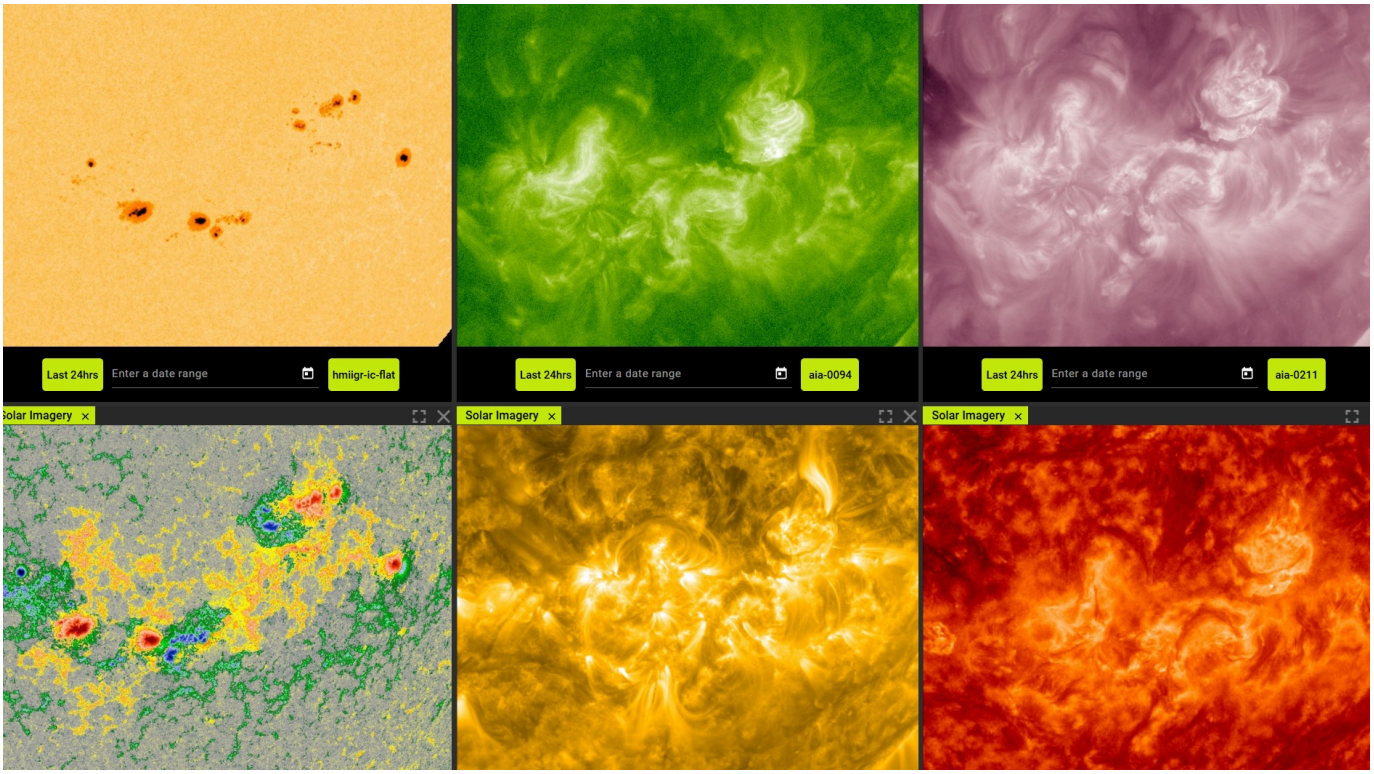

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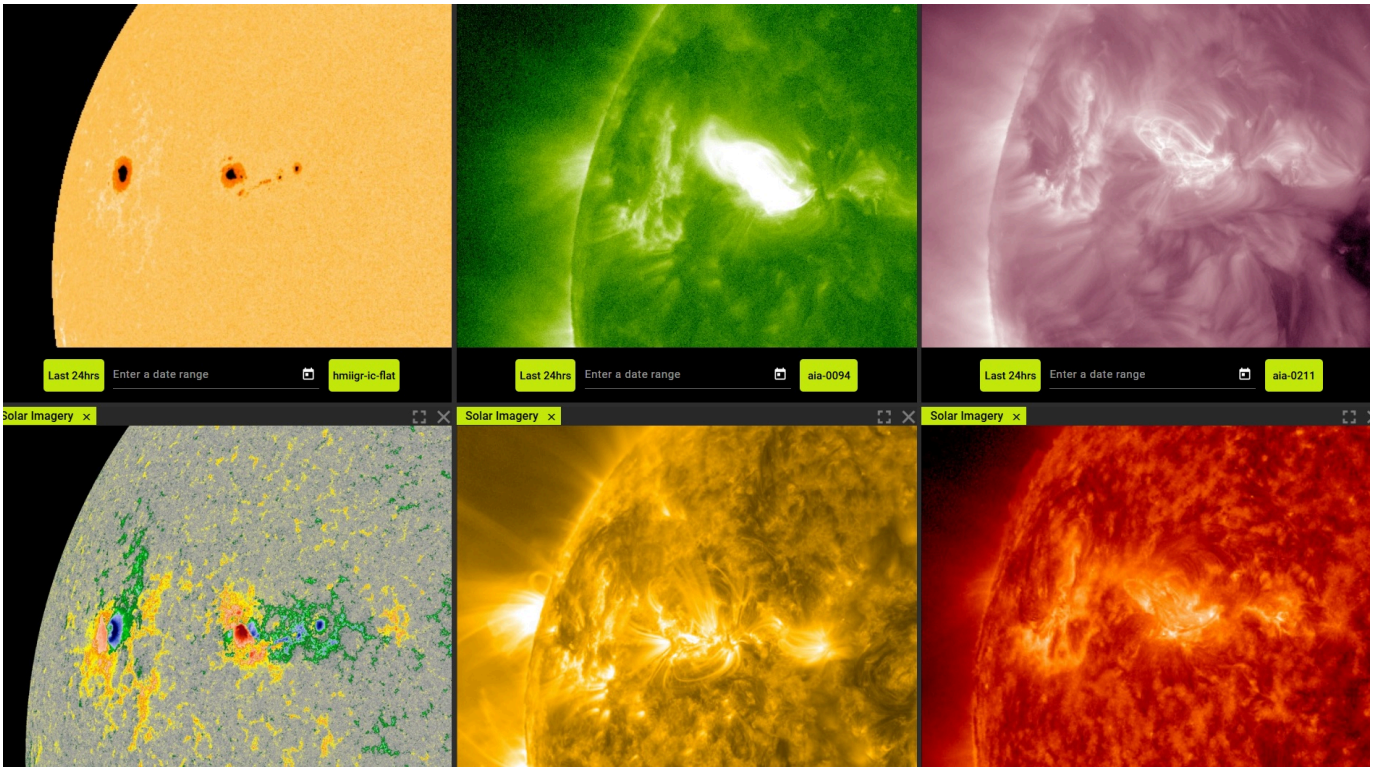
Figure 5: SDO imagery of the NW disc, including AR3878 on the right, source of the recent M7.2 flare.



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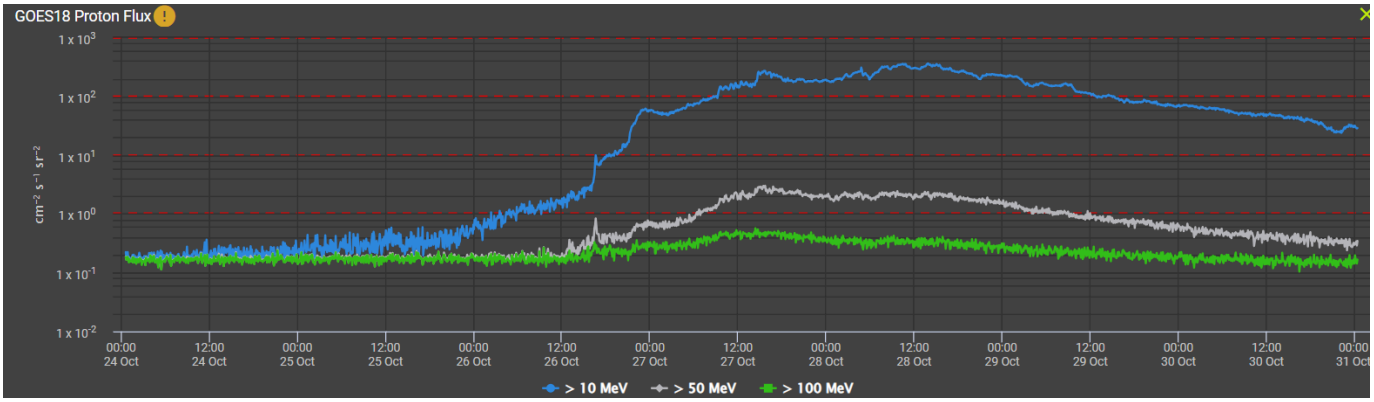
Solar Radiation Storms (High Energy Protons)

Recent CME and X-flare activity elevated the high energy proton flux at GOES-18 over the previous day, which after peaking at S2 Moderate Radiation Storm on 29 Oct, is now easing. This was at S1 Minor Radiation storm level, and is most likely to fall this level below during the coming 24 hours.

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the south-centre disc, plus AR3876 to the northwest of this cluster. Notable flares are also possible from AR3878 in the northeast, and while less likely produce observable protons at Earth, this cannot be ruled out.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	30	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 6: GOES-18 >10 MeV >50 MeV and >100 MeV Proton Flux over the last 7 days.



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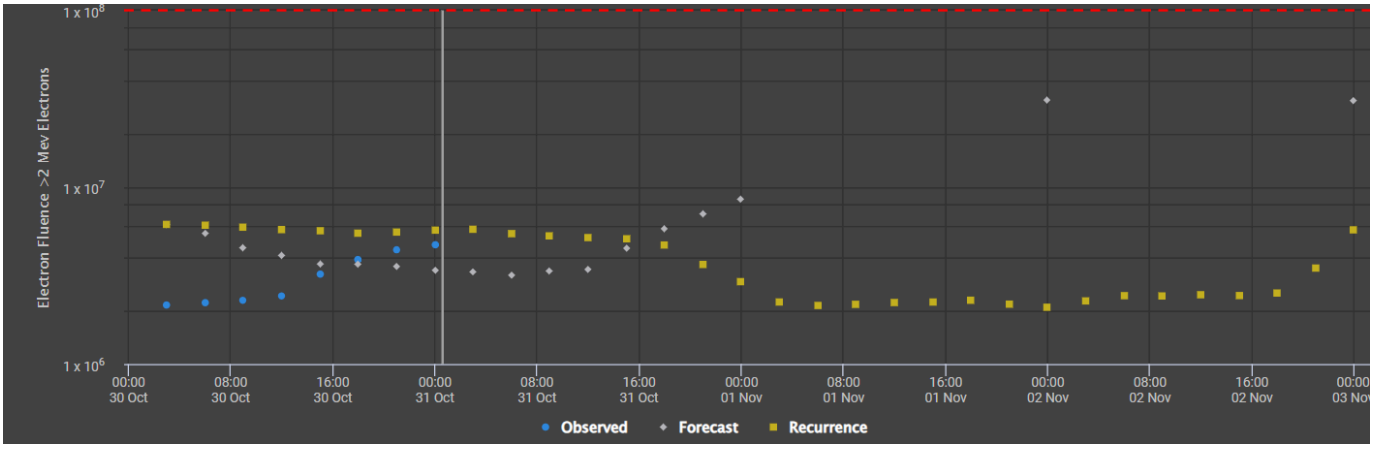
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance to staying below this Active level, although this is likely to over-estimate the forecast fluence due to the current elevated winds.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 7: GOES-16 >10 MeV 24 hour electron fluence with MOSWOC REFM and Recurrence



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